



A Member
of the
SARL



**Antique
Wireless Association
of Southern Africa**

Inside this issue:

CW Net	2
SSB Activity	2
AM	2
The Battle of the Beams—Part 3	3-4
Collecting Vintage QSL's	6
SARRL Display 1932	8
Notices	9

AWA Newsletter

#45

September 2009

Reflections:

In the early 80's, band hear my Signals Officer I also learned that the an-
conditions were so good. I saying "ZS6.... this is tenna was a vital piece of
can remember as a young ZS3EE" and then having a equipment for any communi-
CB enthusiast how I made long conversation with the cations system to work prop-
my own 2 element beam guy on the other end. This
out of conduit tubing, put intrigued me even more.
it up about 5m off the
ground and had worldwide
communications. It was
absolutely fantastic.

It was during that camp
that part of our operations
were to set up a repeater
system in the area for the

commando group to have
contact throughout by
means of VHF. I learned
how to work out antenna
lengths and make wire an-
enna's that operated in
the 50Mhz range. How to
set up a repeater, how to
carry big batteries over
rocky terrain and most im-
portantly I was learning
about communication by
radio.

It was when I got back home
after that camp, I tried mak-
ing the 2 element beam with
such great success. I had a
lot of fun on that antenna as
many CB'ers would know.

Will we see those days of
good easy communication
again ? I'm sure we will. It
may still take a while for Mr
Sun to wake up and start
energising the ionosphere,
but I'm sure it will happen

But a good antenna remains
a Ham's best friend.

Best 73

De Andy ZS6ADY

Wikipedia—The Capacitor

AWA Committee:

- * President—Rad
ZS6RAD
- * Technical—Don ZS5DR
- * Net Controller—Willem
ZS6ALL
- * Newsletter/PRO—
Andy ZS6ADY

In October 1745, Ewald Georg von Kleist of Pomerania in Germany found that charge could be stored by connecting a high voltage electrostatic generator by a wire to a volume of water in a hand-held glass jar. Von Kleist's hand and the water acted as conductors and the jar as a dielectric (although details of the mechanism were incorrectly identified at the time). Von Kleist found that after removing the generator, touching the wire resulted in a painful spark. In a letter describing the experiment, he said "I would not take a second shock for the kingdom of France." The following year, the Dutch physicist Pieter van Musschenbroek invented a similar capacitor, which was named the Leyden jar, after the University of Leyden where he worked. Daniel Gralath was the first to combine several jars in parallel into a "battery" to increase the charge storage capacity.

Benjamin Franklin investigated the Leyden jar and proved that the charge was stored on the glass, not in the water as others had assumed. He also created the term "battery", (as in a battery of cannon), subsequently applied to clusters of electrochemical cells. Leyden jars were later to be made by coating the inside and outside of jars with metal foil, leaving a space at the mouth to prevent arcing between the foils. The earliest unit of capacitance was the 'jar', equivalent to about 1 nanofarad.

CW Net:

Will we ever really see an increase in CW activity on the bands ?

I sometimes think we are flogging a dead horse to get it to move the wagon that no longer exists, but then I listen to the 20m band and hear the stations that are still so active on CW in Europe and the US and a glimmer of hope arises inside of me.

Maybe the problem is we here in SA are too interested in making our stand point known that we don't have to do CW to become real hams. We tried making that stand point in the days when CW was a pre-requisite by staying ZR's to protest the actions of a body trying to rule Amateur radio (or so we thought anyway).

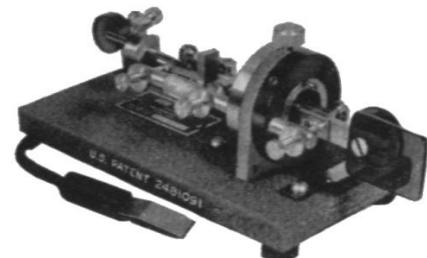
Maybe we still have that perception ? Lets face it, according to the guys who do CW on a regular basis, you haven't experi-

enced amateur radio until you have tried CW.

That being the case, why can't we convince more hams to at least try a bit of CW. If you're not the technical guru that you think you need to be in order to get around the ZR barrier, then CW is still a good option. How difficult can it be to learn to send and receive at 5 words per minute ?

Once upon a time, one could hear CW lessons on many of the repeaters with many a ham either listening in, just to keep themselves tuned in, or the ZR interested in achieving that all illustrious ZS call sign.

Today I don't think it even happens any more. How many of the clubs actually promote the use of CW at all to their ZR



A Dowkey Vibrator

members ?

I may have asked too many questions in this section, but as one of my CW buddies put it, "Real Hams do it in CW".

SSB activity:

It's been another month for the books with conditions being absolutely atrocious for the SSB nets. Not only has 40m been bad, but even 80m has not been that brilliant. Although I must say that 80m is most times a lot better than 40m.

Of course conditions to Div2 always seem to be good with Om Ken ZS2OC and Andre ZS2ACP and showing us how it's done. Then of course in the exact opposite direction is Dudley Z22JE. The only problem is they are the only ones who really show us how to do it on 40m.

80m really seems to have become fairly popular for the SSB net very often having

more call in's than 40m. It works well for the local guys and even gives good Q5 copies to Div 5. Maybe not the strongest, but still Q5.

Ands so we wait with bated breath for the sunspot's to start changing the paths and hope that we are not going to run out of oxygen before it all happens.

There has been discussion around moving the SSB net to a higher frequency with the new allocated frequencies above 7100, although there does seem to be some who are against it.

Let us know your feelings on this. We have already experienced the frequency we have

been using for the last 6 years being taken over on a Saturday morning to be used for rally communications, so maybe it's time for us to find a new slot and settle in. It seems everyone else is scared of using the new frequencies.

Yes there are still a few commercial stations there, but there is plenty of open frequencies where there is no interference from them. Just listen around on the band and you will see.

Give us your opinion, these old boatanchors are able to utilise the bands to their full extent.

AM:

AM has also been rather challenging this last month, but there have been times when communication has been good and signals of 40 over the 9 on carriers have been heard. At those times, AM comms becomes brilliant and the music that abounds on the frequency really becomes quite nostalgic.

Slowly a few more people are being enticed to fire up their AM rigs, but there is also a bunch of regulars out there giving it stick. From Div 5, Don ZS5DR, Gary ZS5NK and Derek ZS5DM, are there most Saturdays. On the odd occasion Munro ZS5IN will also call in.

In Div 6 there is Rad ZS6RAD, Barney

ZS6BLL, Willem ZS6ALL, Andy ZS6ADY and Dave ZS6AAW listening in on his portable at home. Recently we have been joined by Norman ZS6CVF, who has just got his AM station up and running.

When William ZS4L is home we are joined by him too.

Leon ZR6LLS has often sms'd me reports when he listens in on a Saturday morning. So there is room for a few more stations to join us. With summer on its way, don't you think it's time ?

You don't need to have a station that puts out 100w, 30w is more than enough to be heard

around the band. Remember the figures quoted in our Tech Tips about AM ?

So come up and join us on AM. You don't have to play music, but of course we welcome those who have the station to do that too.



RCA AR88 Receiver

The battle of the beams Part 3

By John ZS5JF

The cavity magnetron and microwave radar development.

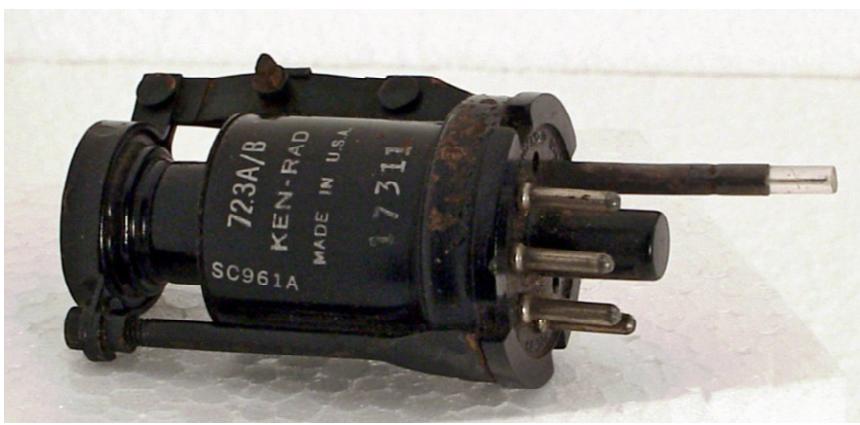
If you ask the average radio amateur who invented the magnetron you most likely will get the answer "Randall & Boot". Unfortunately this isn't true!

The magnetron was invented long before Randall & Boot developed their version in 1940 at Birmingham University, England. Philips, the well known company based in Eindhoven, Holland had been manufacturing magnetrons for several years and were supplying German companies from 1936 onwards for use in radar transmitters. The difference between the magnetron as then known and the version Randall & Boot developed is the power output and frequency range. A conventional magnetron consists of a metal cylinder made from a slice of round bar, often copper because of its good heat transmission properties. A central hole is drilled through the bar to form a doughnut shape. A cathode is inserted in the hole and an anode placed at the top of the hole. A hole drilled in the side of the doughnut carries a coaxial line to which is connected a coupling probe to allow the RF energy to pass to the external antenna. The valve is sealed by glass endplates and then evacuated.

The magnetron is then surrounded by a powerful magnet, either fixed magnets or a field induced by current in a solenoid wound around the device. A high voltage positive potential is placed on the anode and the cathode grounded. The magnetron is essentially a diode valve but the high voltage and the intense magnetic field causes the electron flow from the cathode to the anode to be enhanced, by crowding the electron stream, such that the valve becomes self oscillating. The frequency of oscillation is determined by the dimensions of the internal hole, a larger diameter has a lower frequency. At the time a maximum frequency of about 2 GHz was the upper limit. The copper bar has fins machined into the outside to radiate the heat away and often is forced air-cooled. The typical power output is between 1W and 10W, which is far too low to use in a long range radar, we need power outputs more like 1kW to 10kW. Today the cavity magnetron is most commonly found in use in microwave ovens where output powers of 600W to 1.2kW at 2450 MHz are used. In modern radar applications output powers of several megawatts are common for long range surveillance devices.

So who were Randall & Boot and how did they become the inventors of the famous magnetron?

During the early part of World War 2 Britain stood alone and the only countries amongst the allies were occupied France and remote Russia. So Britain had to enlist help from any country sympathetic to the cause. Amongst the Commonwealth countries, South Africa, Australia, New Zealand and Canada had some scientists who may be able to assist in developing new and better radar to thwart Hitler's plans, but all this was new science and no experience was available. Birmingham University was granted a sum of money to undertake research into microwave radar systems. Two teams were set up; one designing transmitter's and the other team receiver's, Randall & Boot were in the Birmingham University team tasked with developing the transmitter although they were not part of the main team and were detailed to develop microwave detectors. The receiver team was at the Cavendish Laboratory at Cambridge University led by Philip I. Dee.



723-A/B

3cm (10GHz) klystron for radar receiver

Randall & Boot needed a signal generator to allow them to test the detectors they were developing, but no such items had been invented at that time. So they decided to build a low power transmitter based on a klystron valve, a recent development by the brothers Sigurd and Russell Varian at Stanford University in California, and based on a "resonant cavity" through which streams of electrons flowed. The klystron became the de-facto local oscillator for many microwave radar receivers developed during World War 2, delivering a few milliwatts to the receiver mixer stage.

The klystron oscillator proved to be too unstable for their purposes and was quickly discarded and a magnetron seemed to offer the only answer. The only known source of magnetrons was Philips in Holland, which was now occupied by the enemy. (The Philips family had escaped to America taking their fortune when Holland was invaded leaving the factory in German hands, so

none could be obtained). So they decided to make a magnetron from scratch and spent all their spare time learning about magnetrons. Randall & Boot having studied the klystron and normal magnetron decided to try something different, they combined the two technologies to invent a new type of magnetron.

Physicists working with the device would later describe it as a kind of "whistle", where the flow of electrons generated electromagnetic waves of a specific wavelength, just as the flow of air through a whistle generates sound waves of a specific wavelength. The frequency of a whistle is dependent on its size, with a big whistle generating a low sound and a small whistle generating a shrill one. Similarly, the frequency output of the cavity magnetron was dependent on the size of the cavities. The cavities had a diameter of 12mm, confining the electromagnetic radiation to produce "standing waves" at a wavelength of 9.1 cm (3300 MHz). A tap was bored through the side of the cylinder to provide an outlet for the microwave energy generated inside. They called this new version a "Cavity Magnetron".

The cathode and anode was conventional with glass seals and the normal output coupling probe. Having evacuated the new device they coupled it up to a power supply. Not having anything to measure power with, they were after all a receiver laboratory, they bought a small lamp bulb and connected it across the output coaxial line. The filament was first powered up and when it was up to temperature, they switched on the high voltage supply, immediately the lamp blew. So they obtained a handful more of higher wattage lamps and repeated the experiment, every time they switched on the lamp blew. Clearly they had a device generating a lot more power than expected and they next connected a dipole antenna to the output to act as a load. On switching on the cavity magnetron the fluorescent tube above the workbench glowed brightly although it was not switched on!



Randall and Boot performed the first microwave transmission using their cavity magnetron system on 21 February 1940. Within a few days, they were lighting up fluorescent tubes from some distance away, which indicated a power output of about 500 watts. They found this unbelievable and checked and re-checked their figures and experimental set-up. Nothing was wrong. The cavity magnetron was an entirely unexpected leap forward in microwave technology.

Slowly the truth dawned, they had devised a very powerful generator of microwave power, and the first prototype managed over 500W continuous power output (CW) before it failed. A second version was fitted with a water-cooling jacket to get the intense heat away and this device generated more than 2kW CW power for a few hours. (Early microwave generators were extremely inefficient and as little as 20% of the DC power input was converted into useful RF output). Under pulsed operation the power output was safely increased to more than twice this level by raising the HT voltage. Through the spring and early summer, they improved their crude microwave transmitter into something re-

sembling an operational system, with an output power of 15 kilowatts, three orders of magnitude greater than the output power available with any other device. The main team, which had been concentrating on transmitters, saw this was a major breakthrough and threw all its efforts into the Randall & Boot development. Later after the war ended power outputs of megawatts of pulsed power were achieved.

The cavity magnetron opened doors to new technological possibilities. The TRE received its first cavity magnetrons on 19 July 1940. They were supplied to a centimetre-technology group under Philip I. Dee, of the Cavendish Laboratory at Cambridge University, who had originally been the receiver portion of the joint research operation. Dee's team quickly put together a microwave radar system operating at 9.1 cm, though the technology was referred to as "10 centimetre" for convenience, and tracked an aircraft with it on 12 August 1940. The next day the radar tracked a technician riding a bicycle carrying a tin sheet. Ground "clutter" would have simply blinded any long-wavelength radar under such circumstances. Microwave radar had arrived.

What Randall & Boot were unaware of is that a Swiss engineer also had invented this type of magnetron some 5 years previously, and he had published a paper on it. As Randall & Boot were working on receivers they were, not surprisingly, ignorant of this fact, as were everyone else in the Birmingham University team and all the others working on radar in Britain. In fact as time went on several others around the same time claimed the invention and indeed had produced working prototypes of various power outputs on similar frequencies. It should be no great surprise, given the fact that radar itself arose simultaneously in several countries, that several other nations discovered the cavity magnetron at about the same time. Two Soviet engineers, N.F. Alekseev and D.D. Malairov, developed the technology in the late 1930s and published a description of it in a public technical journal in 1940. Magnetron technology was also invented roughly in parallel in Switzerland, France, and Japan. In a further irony, the Japanese design was based on a device built in the mid-1930s by an American engineer, Arthur L. Samuel of Bell Labs, that he never got to work very well. Samuel did make a major contribution to early allied long wave radar work by de-

signing a high-frequency triode vacuum tube known as a "doorknob" for its appearance.

It appears that Randall and Boot, whose naivete in electronics was obvious, knew little or nothing of any efforts similar to their own. Ironically, both the Americans and the Germans had worked hard before the war to come up with a device to generate high power, short wavelength radio signals and missed the cavity magnetron, while the British basically stumbled onto it by accident and ran with it.

However, Britain now had a powerful new microwave generator that would bring in a new era of radar systems. The use of microwave radar meant that smaller and more directional antennas could be used and whilst still being able to achieve adequate range, as the lower frequency radar systems were able to. Britain through the Prime Minister, Winston Churchill, was bargaining with his counterpart, President Roosevelt, in the USA for aid and equipment. America at the time was a neutral country but Roosevelt lobbied the Senate and Congress to allow America to help its long time friends in Britain. Britain was able to purchase much needed equipment and armaments for hard-earned gold bullion from its reserves, but if the war went on for more than another year or two these reserves would be severely depleted. With the Cavity Magnetron now in its possession Britain had a stronger bargaining power. This ultimately concluded with the "Lend-Lease" agreement with the USA.

It was clear that developing "centimetric" radar systems would take time, money, and engineering resources, and Britain was desperately short of all three. Churchill knew that Britain needed American scientific, engineering, and manufacturing resources to win the war. He decided to unconditionally share the cavity magnetron and other British technical secrets with the USA to ensure rapid development and deployment of the new technology.

Edward (Taffy) Bowen of TRE, was tasked with collecting such new developments as might be attractive to the American government and to take them to a meeting in the USA. This was done at the behest of Sir Henry Tizard. Bowen had been assigned to collect papers and hardware for the mission, including a cavity magnetron, and to hand them over to military handlers for the voyage. He packed everything into a black metal box that had been designed to carry deeds and other commercial papers. Though Bowen was a relaxed sort, carrying around so many of Britain's vital secrets in one small box was nerve-wracking, and he was happy to pass the box off to its military escort.

On arrival in America a meeting was arranged with major players and the existence of such a powerful microwave generator, when disclosed to the chosen few, came as a large shock to the American scientists. They had also been working along the same lines, as it was now obvious that America would soon be involved in the war in Europe. American scientists at the time were pursuing the klystron route but were hampered by lack of output power. When Bowen took the cavity magnetron out of his pocket and placed it on the table he said, "This may be the most valuable cargo ever brought to America", how right he was.

In his haste to get the black box ready for shipment to the USA, Bowen had grabbed what seemed to be a perfectly normal magnetron and put it in the box. When the American researchers examined it closely, they found to everyone's consternation that although all the paperwork described the magnetron as having six resonant cavities, the one the Americans actually had in their hands had eight. Bowen had accidentally picked up a one-off experimental prototype. After some discussion, the Americans simply shrugged it off and went with the eight-cavity magnetron. The British would continue to develop microwave devices using magnetrons with six cavities, the Americans using magnetrons with eight. As was later found out when US microwave radar were supplied to Britain, the 8-hole cavity type had a slightly higher output power than the 6-hole British versions.

The cavity magnetron sample was taken to the Massachusetts Institute of Technology (MIT) newly formed Radiation Laboratory, which was heading the American radar experiments. It was connected up and delivered 15-kW of pulsed power, which confounded the scientists, some of them did not believe Britain's claims at first. With the new cavity magnetron in its possession it quickly assembled its first prototype radar, and within 6 weeks had detected ships and US Navy submarines in Boston harbour from the roof of the Radiation Laboratory. A further 4 weeks later a prototype airborne version was flying, giving ranges of up to 10 miles in a test fit in a bomber. From there the radar was quickly put into volume manufacture by Hughes and within a year hundreds of American radar systems were being fitted to British and American bombers and fighters. The mighty Luftwaffe, which started the war with over 5,500 aircraft, would soon be reduced to a few hundred aircraft by the end of the war with this deadly tool.

The initial targets for the new microwave radar were however the deadly German submarines that were causing increasing losses in convoy shipping. With ASV centimetric radar (air to surface vessel) able to see the submarines on the surface at night, where they charged their batteries, the losses fell steadily until the U-boats were almost extinct. The 10cm ASV radar was a huge step forward compared to the existing 200 MHz types then in common use. The VHF types suffered from "sea-clutter" from the surface making it difficult to see the small submarines on the surface at night. Initially the German's developed a receiver called Naxos, to pick up the 10cm signals from the ASV radar and allowing them to dive before the attacking aircraft got within range. Later in the war the team increased the cavity magnetron output up to 10 GHz (3cm), leaving them unable to detect the approaching aircraft and increasingly vulnerable to attack. -.-

By John Dilks, K2TQN

From QST, May 2000

Collecting Vintage QSLs

An enjoyable part of ham radio has always been the exchange of QSL cards. It started in the early days of the hobby when operators wanted confirmation of their contacts. Over the years many of these earliest confirmations have been discarded or lost. Now it has become popular to collect them.

I collect vintage QSLs. I like them all, but I specialize in cards from southern New Jersey because I'm writing a history of Amateur Radio in my area. QSL cards are rich with history and information, and form the corner stone of my book. When the book is completed, I will have a page dedicated to each ham showing his or her QSL card, photo and any personal information I can find.

Additionally, by researching *Callbooks*, I will add information on other calls held by that operator. With luck it will grow to be several pages on each ham. This history will be copied and donated to local historical societies and radio museums. It is my hope that someone in the future will continue to gather information and add to what I have done.

Your Own Collection

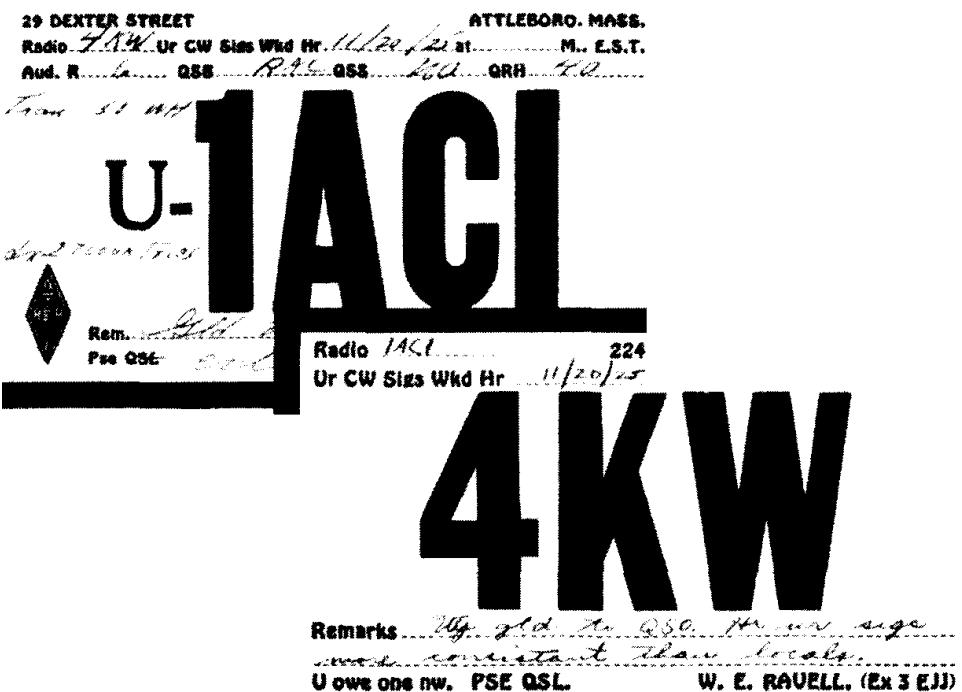
You can begin your QSL collection economically. An easy way to start is to ask some of your friends if they would consider selling you a few of their old cards. You may find more sources by placing an ad in your local club newsletter. You can also ask fleamarket vendors at hamfests,

Estate sales can be productive. Many times the cards and other important papers are considered trash. If you're lucky, they may just give them to you. Occasionally, you can find QSLs in antique shops, although they tend to be more expensive.

There are several collecting *themes* you might like to try. Local cards are a great way to generate interest at your club meetings. The old timers will remember some of the calls and start telling stories about them. Another idea would be to get a card from every state for each decade. How about YL QSLs, photo cards, or original art cards? Use your imagination to make your collection unique.

An Interesting Story That Started In 1925

On a trip to New England last year I attended a radio meet. A seller showed up with a pile of radios from a local auction house. Among the pile was a shoe box full of QSL cards. Someone told him they were worth a fortune and he wanted a lot of



Confirming a contact between my Elmer (4KW at the time) and 1ACI almost 75 years ago, these QSLs hold a place of honor in my collection.

money for them. I asked if I could look through the box.

The cards were from the 1920s and 1930s. About half the way through the box, I spotted a 4KW card from one of my Elmers who had been operating as a young boy at the time in Atlanta. The card was dated November 20, 1925. He had sent it to 1ACI in Attleboro, Massachusetts. I became excited and tried to buy the card. The fellow let me have it for a buck after I told him why I wanted it so badly.

After returning home I visited my Elmer at the first opportunity. He had just celebrated 75 years in ham radio, so there was a lot to talk about. Later, I said I had something to return. I gave him the card and told the story of how I had acquired it. We talked about 1ACI and the QSO. Atlanta to Massachusetts was a great contact for a 5 W station in those days.

As I was getting ready to leave, he asked me to wait. Reaching under his desk, he pulled out an old shoebox. Inside, organized in perfect order, were his 1920s QSL cards. In a few seconds he located the matching QSL card from that QSO so long ago. He told me to place both QSLs in my museum, which I was honored to do.

Experiences like these make collecting so much fun. You never know when you will find something special.

Please check my Web site for additional QSL card information, including some interesting and rare cards on display at: <http://www.eht.com/oldradio/arll/index.html>. I also have a schedule there for the Old Radio Museum.

K2TQN'S OLD RADIO MUSEUM SCHEDULE FOR MAY 2000

I was invited to bring the Old Radio Museum to the Trenton Computer Festival, in Edison, New Jersey on May 6 and 7. This is their 25th anniversary and they are planning, as part of this year's show, a large display of vintage computer equipment, my Old Radio Museum, and a display from the New Jersey Antique Radio Club. There are many Amateur Radio activities scheduled, including VE testing. For more information, check their Web site at: <http://www.tcf-nj.org/>. This is a big show with 500 inside exhibitor spaces and 1000 tailgating spaces. Look for my call letters on my hat and say hello.

Use

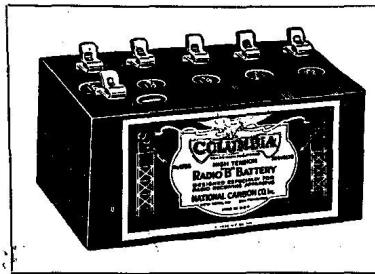
Columbia

RADIO BATTERIES

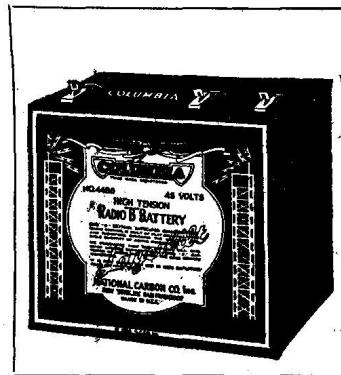
THEY LAST LONGEST



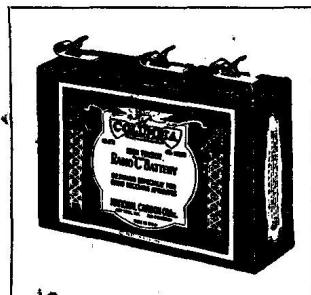
45 Volts, Layer Built, 20/-



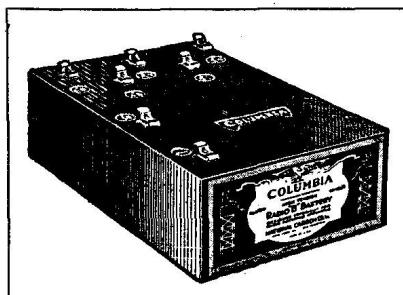
22½ Volts, 12/6



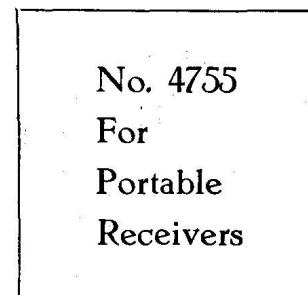
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The League Stand at the First South African Exhibition of Models, Hobbies and Handcrafts



Not to be outdone by the other Divisions of the League, Members of Division Six took the splendid opportunity offered by the Hobbies and Models, Exhibition, held in Johannesburg on the 13th, 14th and 15th of October 1932, to stage an excellent exhibit of member-built apparatus.

The exhibit was interesting in the extreme, and OM Ussher must be congratulated on the result of his untiring energy. This OM worked early and late to ensure a good display and, of course, assistance was not lacking from various other keen Members, except at one memorable moment when, during the effort to put the huge loudspeaker, part of a fine public address system, up on to the roof of the stand, disaster seemed certain. It was curious how many Hams found it necessary to go out and inspect the rest of the show whilst this dangerous job was being done; but to the credit of the

League, let it be said, the speaker went up and stayed up, and its excellent duty performed, came safely down again. This public address outfit proved of fine advertising value, as it was used to provide music throughout the exhibition, also for announcements, S.O.S. calls and directions to the public.

During the evening OM Law's transmitter, which had been erected on the stand, was in operation and the musical programme from the stand, was relayed, messages were sent and received at various times.

Consistent homage was paid by admiring public and Hams, the stand became the Ham centre of the city-to the cabinet-making and radio skill of OM McCash, whose double-barreled, sorry, twin-speaker-radio gramophone outfit can be seen in the front right of our photograph.

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**Antique Wireless Association
of Southern Africa**

Mission Statement

Our aim is to facilitate, generate and maintain an interest in the location, acquisition, repair and use of yesterdays radio transmitters and receivers. To encourage all like minded amateurs to do the same thus ensuring the maintenance and preservation of our amateur heritage.

Membership of this group is free and by association.

Notices:**Swop/Sale:**

The following items for sale from a deceased estate. These items are available from Andy ZS6ADY.

1. RCA AR88 Receiver—R700 onco



2. Viking Ranger II AM Transmitter R600 onco



3. Barrie ZS2H has for disposal a Hallicrafters HT37 Transmitter and a Hallicrafters SX101 Receiver in good working condition. Also available is a Heathkit HW32 20m transceiver with power supplies. Contact Barrie at zs2h@pears.ham-radio-op.net or on 041 360 3052.